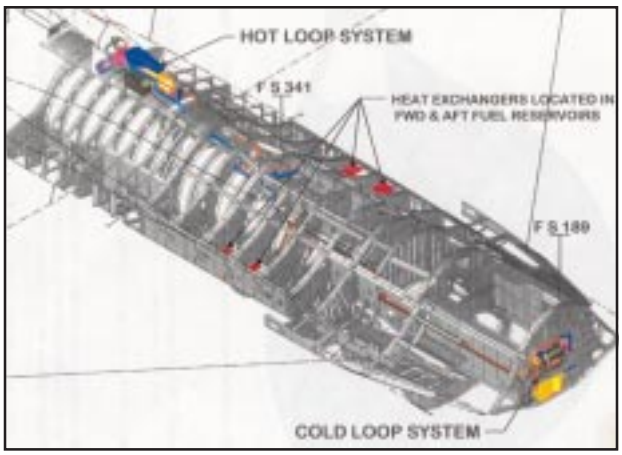
New Avionics Cooling System Gives New Life to the F-16 Aircraft



Payoff

By designing a separate heat pump to cool avionics, the F-16 aircraft can now be retrofitted with state-of-the-art electronic equipment without the cost of re-designing modules or aircraft cooling systems. Foster-Miller's vapor-cycle heat pump will increase the cooling capacity of the existing F-16 environmental control system by 50 percent, making it a very cost effective and efficient thermal management approach. This program allows fielded aircraft to upgrade avionics with state-of-the-art line replaceable modules to help them maintain their air superiority. The commercialization of this heat pump system by Fairchild will allow smaller, corporate aircraft to take advantage of avionics upgrades as well.

Accomplishment

Using Small Business Innovation Research (SBIR) program funding, the Air Force Research Laboratory's (AFRL's) Sensors Directorate (SN), contracted with Foster-Miller Inc., Waltham, MA, to develop an avionics liquid cooling system for currently fielded aircraft and the retrofit of state-of-the-art avionics. Their system's electrically driven vapor-cycle heat pump, integrated into the F-16's current cooling system, will allow this aircraft to be incrementally updated well into the next millennium with advanced, reliable avionics and capabilities at low cost.

Background

Today's deployed aircraft use an air cooling system for thermal management of electronics and avionics. To defeat modern hostile threats, fielded aircraft vitally need avionics and electronic packaging upgrades to replace outdated equipment. However, new advanced electronics, like the type produced for the F-22, require liquid cooling, low coolant temperatures and increased cooling capacity. Currently, fielded aircraft, such as the F-16, do not provide liquid cooling to meet the specifications needed for modern avionics. The Air Force's F-16 fighter aircraft avionics obtains cooling from the aircraft's environmental control system, which operates with bleed air taken from the jet engine compressor. However, the control system does not have the lower temperature cooling capacity required for modern electronic modules. Meeting temperature specifications would require costly modifications to both the environmental control system and the aircraft. An alternate solution to this problem is an on-board vapor-cycle heat pump, which uses available electrical power to provide liquid coolant to avionics. Two major problems - compact design and available heat sink - had to be solved before this system could be implemented. Foster-Miller located off-the-shelf compact heat exchangers and compressors to address the volume constraints, as well as, to reduce the system's costs. Ram air provides a direct usable heat sink for much of the F-16's flight envelope. For a cooling capability of up to 5 kilowatt, a two-stage heat pump configuration is used. The first stage, the "cold loop," consists of a heat pump pulling the heat away from the electronics package and dumping this heat into the fuel. A second heat pump, the "hot loop," independently cools the fuel by rejecting heat directly to ram air. Though designed for the F-16 aircraft, many aspects of the cooling system can apply to other aircraft such as the F-15 and F-18. Fairchild Control Corporation, the designer and builder of the compact compressor for Foster-Miller, is in the process of exploring commercial applications for this compressor system.